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Presented for filing is a new original patent application of:

Applicants: MARK E. KRIEGSMAN AND BENJAMIN W. WYCKOFF

Title: SERVING DYNAMIC WEB-PAGES

Enclosed are the following papers, including those required to receive a filing date under 37 CFR 1.53(b):

	<u>Pages</u>
Specification	8
Claims	5
Abstract	1
Declaration	1
Drawing(s)	2

Enclosures:

- Small entity statement. This application is entitled to small entity status.
- Postcard.

Basic filing fee	\$345
Total claims in excess of 20 times \$9	\$72
Independent claims in excess of 3 times \$39	\$0
Fee for multiple dependent claims	\$0
Total filing fee:	\$417

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Under 37 CFR §1.53(f), no filing fee is being paid at this time.

If this application is found to be incomplete, or if a telephone conference would otherwise be helpful, please call the undersigned at (617) 542-5070.

Kindly acknowledge receipt of this application by returning the enclosed postcard.

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Respectfully submitted,

A handwritten signature in black ink, appearing to read "Faustino A. Lichauco", with a horizontal line extending to the right.

Faustino A. Lichauco

Reg. No. 41,942

Enclosures

FAL/deg

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Applicant or Patentee: Mark E. Kriegsman and Benjamin W. Wyckoff

Serial or Patent No.:

Filed or Issued:

For: SERVING DYNAMIC WEB-PAGES

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) and 1.27(c)) — SMALL BUSINESS CONCERN

I hereby declare that I am

☐ the owner of the small business concern identified below:☒ an official of the small business concern empowered to act on behalf of the concern identified below:

Name of Small Business Concern: CLEARWAY TECHNOLOGIES, LLC

Address of Small Business Concern: 31 St. James Avenue, Suite 925
Boston, MA 02116

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.802, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees to the United States Patent and Trademark Office, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, entitled SERVING DYNAMIC WEB-PAGES by inventor(s) MARK E. KRIEGSMAN described in:

☒ the specification filed herewith.☐ application serial no. __, filed __.☐ patent no. __, issued __.

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e). *NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

Full Name:

Address:

☐ INDIVIDUAL ☐ SMALL BUSINESS CONCERN ☐ NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status when any new rule 53 application is filed or prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent on which this verified statement is directed.

Name:	
Title:	
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APPLICATION
FOR
UNITED STATES LETTERS PATENT

TITLE: SERVING DYNAMIC WEB-PAGES
APPLICANT: MARK E. KRIEGSMAN AND BENJAMIN W. WYCKOFF

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Date of Deposit September 22, 2000

Signature Samantha Bell

Typed or Printed Name of Person Signing Certificate Samantha Bell

SERVING DYNAMIC WEB-PAGES

The invention relates to serving dynamic web-pages, and in particular, to the updating of obsolete portions of a dynamic web-page.

BACKGROUND

5 A dynamic web-page typically includes one or more static objects and one or more dynamic objects. Serving a web-page thus includes assembling these objects and integrating them to form a web-page.

10 The static objects are those objects that change rarely, if at all. Examples of such objects include company logos or general instructions and forms for ordering merchandise, biographies of key personnel, and general background about the company serving the web-page.

15 Dynamic objects are those objects that change frequently. For example, a catalog of merchandise may include notice of special sales that must be updated at regular intervals. Stock prices or news items are often updated on a daily basis. In another example, a web-page can include objects that are uniquely associated with a user requesting the web-page. One common example of such an object can be found in web-pages that greet a repeat customer by name. These components must be updated every time a user requests the web-page.

20 A modern web-serving system is typically a distributed system in which an origin server is in communication with a plurality of caches. Static components of a web-page are typically stored in the caches, whereas dynamic components of the web-page are generated by the origin server. In such a system, the process of assembling a web-page for serving to a customer involves retrieval of a variety of constituent objects from various locations. A distributed web-serving system of this type is advantageous because
25 it frees the origin server from having to provide static objects.

 A disadvantage of the foregoing distributed web-serving system is that although dynamic objects need to be periodically updated, they do not always need to be updated each time a request is made. For example, a dynamic object that lists the daily price of

various commodities needs to be updated only once a day. A dynamic object that lists available items needs to be updated when the last unit of a particular item has been sold.

The updating of dynamic objects often involves execution of a database query by the origin server. For example, when a customer wishes to view what items are being offered for a special discount, the origin server may need to formulate a database query that not only asks for a list of what items are on sale but also determines the number of such items available for sale.

To further reduce the load on the origin server, it is preferable that these dynamic objects also be cached and that the cache be updated periodically to avoid the serving of obsolete dynamic components. Where the generation of a dynamic object requires execution of a database query that is expected to be common to many requesting users, it is useful to cache the results of that query to avoid having the origin server needlessly re-execute the same query.

Existing cache management software is not capable of gracefully accommodating the caching of dynamic web-pages. The conventional method of managing a cache of dynamic web-pages is to assign to each dynamic object a date on which that object becomes stale and must be updated. A disadvantage of this method is that it assumes that a stale date, which is to some extent arbitrarily assigned, is a definitive indicator of whether a dynamic object needs to be updated. In fact, there may be occasions when a dynamic object becomes obsolete long before its stale date. Conversely, there may be occasions when a dynamic object remains current long after the stale date.

SUMMARY OF THE INVENTION

A web-serving system according to the invention enables the contents of cache memory to be controlled with greater flexibility by providing a programmable script in communication with a cache manager. Because the script is programmable, it can be customized by a programmer. In particular, the programmable script can be made to detect and respond to a triggering event and to instruct the cache manager to alter the content of cache memory in response to that triggering event.

In one aspect of the invention, the web-serving system also includes a usage-monitor for collecting access-data indicative of the frequency with which a selected web-page is requested. The usage-monitor optionally provides the access-data to the programmable script. The programmable script can use this data to alter the content of cache memory in response to the access-data.

In another aspect of the invention, the web-serving system includes a communication path between the programmable script and an administrator process. This communication path enables the programmable script to receive instructions from the administrator process.

Other features and advantages of the invention will be apparent from the following detailed description, the claims, and the accompanying drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a distributed web-serving system incorporating the invention; and

FIG. 2 is a centralized web-serving system also incorporating the invention.

DETAILED DESCRIPTION

A system 10 embodying the invention, as shown in FIG. 1, includes an origin server 12 in communication with a cache server 14 and a database 16. The origin server 12 supports a database engine 18 for formulating and executing database queries in response to instructions issued by an administrator process 20, also supported by the origin server 12. The database 16 stores data that is used to create dynamic web-pages. For example, if the origin server 12 is associated with a retailer, the database may include current inventory and pricing information, or information regarding weekly specials. The origin server 12 is typically in communication with the cache server 14 over a first internet link 22. Although only a single cache server 14 is shown in FIG. 1, it is understood that the system 10 can include many geographically dispersed cache servers 14.

The cache server 14 supports a cache manager 24 that fetches and stores constituent objects of web-pages in a cache memory 26. These objects are provided to the

cache manager **24** by the administrator process **20** running on the origin server **12**. When necessary, the administrator process **20** provides replacement web-page objects to the cache manager **24**, which then replaces corresponding obsolete objects that are resident in the cache memory **26**.

5 A browser **28** executing on a client machine **30** typically requests web-pages from a web site served by the origin server **12**. In a distributed web-serving system **10**, the browser's requests are automatically redirected to an available cache server **14** such as that shown in FIG. 1. The browser thus establishes communication with the cache manager **24** over a second internet link **32**, as shown in FIG. 1.

10 In response to the request for a web-page, the cache manager **24** identifies the constituent objects of the web-page and where they are stored. Some of those objects are already available in the cache memory **26**. Under these circumstances, the cache manager **24** fetches these objects from the cache memory **26** and provides them to a page assembler **34** for inclusion in the web-page.

15 Other constituent objects of the web-page are not available from the cache memory **26**. For these missing objects, the cache manager **24** issues a request to the administrator process **20** on the origin server **12**. In response, the administrator process **20** prepares the missing objects, if necessary, and provides them to the cache manager **24**. The cache manager **24** provides the missing objects to the page assembler, which then
20 completes the web-page and provides the assembled web-page to the cache manager **24** for delivery to the client machine.

The step of requesting missing objects of a web-page is a source of delay in serving clients. It is thus desirable to maintain as much of the web-page in the cache memory **26** as possible. There are two constraints that impose limits on what can be
25 stored in the cache memory **26**: the finite capacity of the cache memory **26** and the tendency of objects stored in the cache memory **26** to become obsolete.

Because the cache memory **26** has a limited capacity, it is preferable that only the most frequently requested objects be stored in it. This requires that, at some point, a

prediction be made concerning how frequently requested a particular object is expected to be.

In some cases, this prediction is simple. If every web-page contains a graphic image with the company logo, then clearly that component should be stored in cache
5 memory **26**.

In other cases, however, the popularity of a web-page may vary depending on unpredictable external events. For example, changes in fashion may gradually make web-pages offering the sale of certain items more popular. The random occurrence of newsworthy events may cause feature articles on previously obscure topics to surge in
10 popularity for a limited, and unpredictable, time.

In addition to its limited capacity, cache memory **26** has limited currency. Unless steps are taken to periodically update cache memory **26**, objects stored therein will be served to clients long after they have become obsolete. In some cases, it is possible to replace objects at appropriate times because the nature of those objects renders their
15 obsolescence predictable. For example, an object listing the daily closing price of a stock, by definition, requires daily replacement.

In other cases, however, obsolescence can strike an object at any time, with little or no warning. For example, if an object lists special sale items available at a store, it is entirely possible that the sale will be so successful that inventory of certain popular items
20 will be prematurely depleted. Under these circumstances, the object may become obsolete long before it is scheduled to be updated.

Constituent objects in the cache memory **26** typically carry information specifying a date and time on which they should be replaced. In such cases, the cache manager **24** need only monitor the time and transmit a request for an updated web-page at the
25 appropriate time. This is a disadvantage because, as noted above, an object may need to be replaced prematurely, either because an unpredictable event occurred or because an event occurred at an unpredictable time. Since the conventional cache manager **24** will

only replace a web-page on its designated date, the premature replacement of a web-page is difficult.

To address the foregoing disadvantages, a system **10** according to the invention provides communication between the cache manager **24** and a programmable script **36**.

5 The programmable script **36** can be a set of JavaScript instructions provided by a programmer. The script **36** can thus cause the cache manager **24** to update selected constituent objects of a web page upon the occurrence of a programmer-defined triggering event. One such triggering event can, of course, be the passage of a selected amount of time. However, because the script **36** is freely programmable, the triggering
10 event can be any event that can be defined by the script **36**. For example, if more than five clients order the same item, the script **36** can issue a request for an update from the origin server **12** even though the designated replacement time for a particular object may not have arrived. The programmable script **36** thus liberates the cache manager **24** from relying solely on the passage of time as a triggering event for replacing constituent
15 objects of web-pages.

If a web-page increases in popularity, or if its popularity exceeds a threshold, it may be preferable to store the constituent objects of that web-page in the cache memory **26** if they are not already there. Conversely, if a particular web-page is decreasing in popularity, or if the popularity of a web-page falls below a threshold, it may be preferable
20 to remove the constituent objects of that web-page from the cache memory **26** to free space for objects associated with more popular web-pages.

To enable it to engage in such adaptive behavior, the web-serving system can further include an optional usage monitor **38** to collect access-data that illuminates the types of web-pages being requested by client machines. With the usage-monitor **38** in
25 place, the cache manager **24** is able to identify trends in the popularity of particular web-pages. If, on the basis of access-data provided by the usage-monitor **38**, a script **36** determines that a particular web-page has become, or is about to become more popular, it can instruct the cache manager **24** to request copies of the constituent objects of that web page for storage in the cache memory **26**. Conversely, if on the basis of access-data

provided by the usage-monitor **38**, the script **36** determines that a web-page is no longer as popular as it once was, it can instruct the cache manager **24** to remove the constituent components of that web page from the cache memory **26**.

The usage-monitor **38** and the script **36** thus combine to create a feedback control
5 system in which the measured variables are the popularities of particular web-pages and the controlled variables are the locations of constituent objects of various web-pages. The usage-monitor **38** obtains access-data concerning the measured variables and provides them to the script **36**, which functions as a controller. On the basis of that access-data, the script **36** causes the cache manager **24** to adaptively manage the contents of the cache
10 memory **26**.

The script **36** can also take access-data from the usage-monitor **38** and, instead of acting upon it as described above, it can report that access-data to the administrator process **20**. This access-data can then be made available to human analysts who can then propose new rules to be implemented as scripts.

There also exist web-serving systems that are not distributed systems such as that
15 shown in FIG. 1. Such web-serving systems also benefit from having a high-speed cache memory in which frequently requested constituent objects of web-pages are stored for rapid retrieval. A representative web-serving system of this type is shown in FIG. 2.

In the web-serving system **40** of FIG. 2, the cache memory **26**, the cache manager
20 **24**, the usage monitor **38**, the page assembler **34**, and the script **36**, all reside on the origin server **12**. In the embodiment of FIG. 2, there is thus no need to redirect requests for web-pages to a cache server because there is no cache server to redirect to. Instead, requests for web-pages are directly intercepted by the usage monitor **38**.

The invention can be implemented in hardware or software, or a combination of
25 both. The invention can be implemented in computer programs using standard programming techniques following the method steps and figures described herein. The programs should be designed to execute on programmable computers each comprising a processor, a data storage system (including memory and/or storage elements), at least one

input device, and at least one output device, such as a CRT or printer. Program code is applied to input data to perform the functions described herein and generate output information. The output information is applied to one or more output devices such as a CRT, as described herein.

- 5 Each program is preferably implemented in a high level procedural or object oriented programming language to communicate with a computer system. However, the programs can be implemented in assembly or machine language, if desired. In any case, the language can be a compiled or interpreted language.

- 10 Each such computer program is preferably stored on a storage medium or device (e.g., ROM or magnetic diskette) readable by a general or special purpose programmable computer, for configuring and operating the computer when the storage media or device is read by the computer to perform the procedures described herein. The system can also be considered to be implemented as a computer-readable storage medium, configured with a computer program, where the storage medium so configured causes a computer to
15 operate in a specific and predefined manner to perform the functions described herein.

 Having described the invention, and a preferred embodiment thereof, what we claim as new and secured by letters patent is:

CLAIMS

1. A method for enabling the generation of an updated web-page in a cache, said method comprising:
 - implementing a programmable rule defining a triggering event, the occurrence of which is indicative of the existence of an obsolete portion of said web-page;
 - detecting the occurrence of said triggering event;
 - in response to the occurrence of said triggering event, requesting an update of said obsolete portion; and
 - receiving an updated portion of said web-page for storage in said cache.
2. The method of claim 1, further comprising
 - generating a web-page incorporating said updated portion therein; and
 - serving said web-page to a user.
3. The method of claim 1, wherein implementing said programmable rule comprises interpreting a script containing instructions for defining said rule.
4. The method of claim 1, wherein detecting said triggering event comprises detecting an elapsed time defined by said programmable rule.
5. The method of claim 1, wherein detecting said triggering event comprises detecting the receipt of an updated portion of said web-page.
6. The method of claim 1, wherein requesting an updated portion of said web-page comprises formulating a database query to be carried out by a database engine.
7. The method of claim 1, wherein said web-page comprises, in addition to said updated portion, a plurality of constituent portions and said method further comprises providing an assembly script containing instructions for assembling said constituent portions and said updated portion into said web-page.

8. The method of claim 1, wherein

requesting an update comprises establishing communication with an origin
server and requesting said update therefrom, and

receiving an updated portion comprises receiving said updated portion from said
origin server.
9. The method of claim 8, further comprising a cache memory element separate
from said origin server.
10. The method of claim 8, further comprising a cache memory element at said origin
server.
11. The method of claim 1, further comprising collecting access-data indicative of
how frequently said web-page is requested.
12. The method of claim 11, further comprising managing the content of said cache in
response to said access-data.
13. A web-serving system comprising:

a cache memory having content stored therein;

a cache manager in communication with said cache memory for controlling said
content of said cache memory; and

a programmable script in communication with said cache manager for detecting
the occurrence of a triggering event, and in response to said triggering event,
instructing said cache manager to alter said content of said cache memory.
14. The web-serving system of claim 13, further comprising a usage-monitor for
collecting access-data indicative of the frequency with which a selected web-page
is requested.

15. The web-serving system of claim 14, wherein said usage-monitor provides said access data to said programmable script, and said programmable script alters said content of said cache memory in response to said access-data.

16. The web-serving system of claim 13, further comprising a communication path between said programmable script and an administrator process, said communication path enabling said programmable script to receive instructions from said administrator process.

17. The web-serving system of claim 13 further comprising a page assembler containing instructions for assembling constituent portions of said web-page into said web-page.

18. The web-serving system of claim 13 wherein said programmable script is a Java script.

19. A computer-readable medium having encoded thereon software for enabling the generation of an updated web-page in a cache, said software comprising instructions for:

implementing a programmable rule defining a triggering event, the occurrence of which is indicative of the existence of an obsolete portion of said web-page;

detecting the occurrence of said triggering event;

in response to the occurrence of said triggering event, requesting an update of said obsolete portion; and

receiving an updated portion of said web-page for storage in said cache.

20. The computer-readable medium of claim 19, wherein said software further comprises instructions for:

generating a web-page incorporating said updated portion therein; and

serving said web-page to a user.

21. The computer-readable medium of claim 19, said instructions for implementing said programmable rule further comprise instructions for interpreting a script containing instructions for defining said rule.
- 5 22. The computer-readable medium of claim 19, wherein said instructions for detecting said triggering event comprise instructions for detecting an elapsed time defined by said programmable rule.
23. The computer-readable medium of claim 19, wherein said instructions for detecting said triggering event comprise instructions detecting the receipt of an updated portion of said web-page.
- 10 24. The computer-readable medium of claim 19, wherein said instructions for requesting an updated portion of said web-page comprise instructions for formulating a database query to be carried out by a database engine.
- 15 25. The computer-readable medium of claim 19, wherein said web-page comprises, in addition to said updated portion, a plurality of constituent portions and said computer-readable medium further comprises instructions for assembling said constituent portions and said updated portion into said web-page.
- 20 26. The computer-readable medium of claim 19, wherein
said instructions for requesting an update comprise instructions for establishing communication with an origin server and requesting said update therefrom,
and
said instructions for receiving an updated portion comprise instructions for receiving said updated portion from said origin server.
- 25 27. The computer-readable medium of claim 19, wherein said software further comprises instructions for collecting access-data indicative of how frequently said web-page is requested.

28. The computer-readable medium of claim 27, wherein said software further comprises instructions for managing the content of said cache in response to said access-data.

ABSTRACT

A web-serving system for managing a cache memory having constituent objects of a web-page stored therein includes a cache manager in communication with the cache memory for controlling the content of the cache memory. A programmable script in communication with the cache manager detects the occurrence of a triggering event. In response to the triggering event, the programmable script instructs the cache manager to alter the content of the cache memory.

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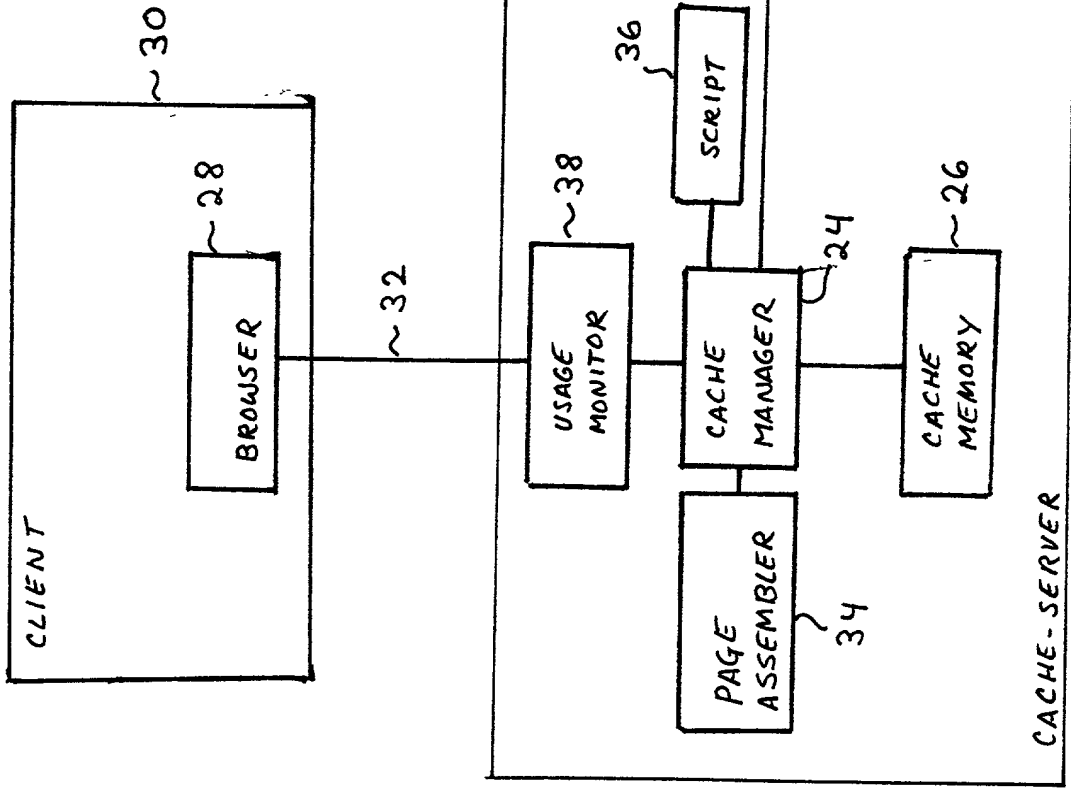


FIG. 1

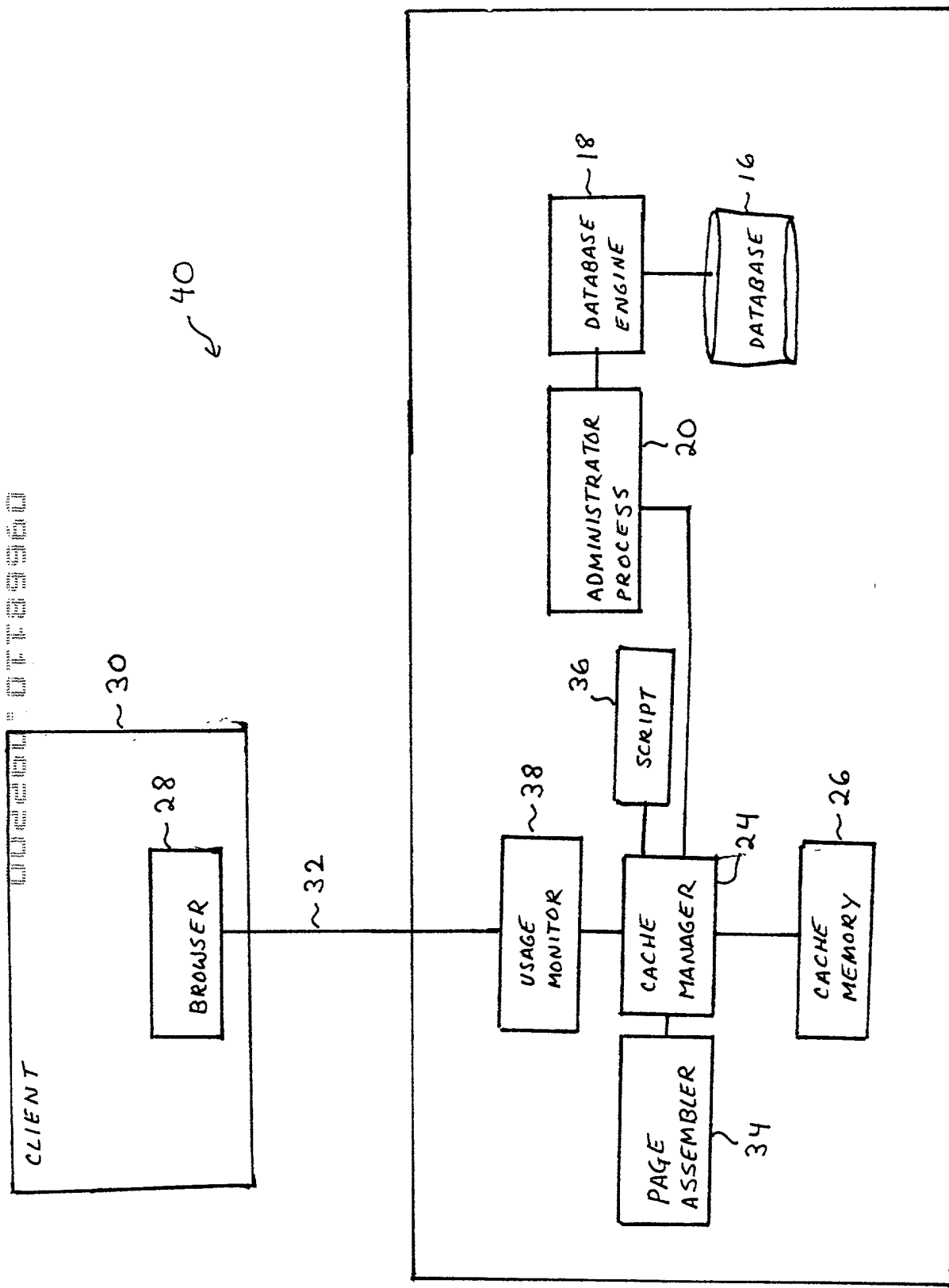


FIG. 2

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled SERVING DYNAMIC WEB-PAGES, the specification of which:

☒ is attached hereto.

☐ was filed on _ as Application Serial No. _ and was amended on _____.

☐ was described and claimed in PCT International Application No. _____ filed on _____ and as amended under PCT Article 19 on _____.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information I know to be material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby appoint the following attorneys and/or agents to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

Gary A. Walpert, Reg. No. 26,098

Faustino A. Lichauco, Reg. No. 41,942

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patents issued thereon.

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Inventor's Signature:	_____	Date:	_____
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